

Metrics of Balance Control for Use in Screening Tests of Vestibular Function

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Decrements in balance control have been documented in astronauts after space flight. Reliable measures of balance control are needed for use in postflight field tests at remote landing sites. Diffusion analysis (DA) is a statistical mechanical tool that shows the average difference of the dependent variable on varying time scales. These techniques have been shown to measure differences in open-loop and closed-loop postural control in astronauts and elderly subjects. The goal of this study was to investigate the reliability of these measures of balance control. Eleven subjects were tested using the Clinical Test of Sensory Interaction on Balance: the subject stood with feet together and arms crossed on a stable or compliant surface, with eyes open or closed and with or without head movements in the pitch or yaw plane. Subjects were instrumented with inertial motion sensors attached to their trunk segment. The DA curves for linear acceleration measures were characterized by linear fits measuring open- (D_s) and closed-loop (D_l) control, and their intersection point (X-int, Y-int). D_s and Y-int showed significant differences between the test conditions. Additionally, D_s was correlated with the root mean square (RMS) of the signal, indicating that RMS was dominated by open-loop events (< 0.5 seconds). The Y-int was found to be correlated with the average linear velocity of trunk movements. Thus DA measures could be applied to derive reliable metrics of balance stability during field tests.

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